

sides) ragged and indented like a Saw: which inequality of their limbs, I have further observ'd, not to remain always the same, but to be continually chang'd by a kind of fluctuating motion, not unlike that of the waves of the Sea; so as that part of the limb, which was but even now nick'd or indented in, is now protuberant, and will presently be sinking again; neither is this all, but the whole body of the Luminaries, do in the *Telescope*, seem to be depress'd and flatt'd, the upper, and more especially the under side appearing neerer to the middle then really they are, and the right and left appearing more remote: whence the whole *Area* seems to be terminated by a kind of Oval. It is further observ'd, that the body, for the most part, appears red, or of some colour approaching neer unto it, as some kind of yellow; and this I have always mark'd, that the more the limb is flatt'd or ovalled, the more red does the body appear, though not always the contrary. It is further observable, that both fix'd Stars and Planets, the neerer they appear to the Horizon, the more red and dull they look, and the more they are observ'd to twinkle; in so much, that I have seen the Dog-starr to vibrate so strong and bright a radiation of light, as almost to dazle my eyes, and presently, almost to disappear. It is also observable, that those bright scintillations neer the Horizon, are not by much so quick and sudden in their consecutions of one another, as the nimbler twinklings of Stars neerer the Zenith. This is also notable, that the Stars neer the Horizon, are twinkled with several colours; so as sometimes to appear red, sometimes more yellow, and sometimes blue, and this when the Starr is a pretty way elevated above the Horizon. I have further, very often seen some of the small Stars of the fifth or sixth magnitude, at certain times to disappear for a small moment of time, and again appear more conspicuous, and with a greater luster. I have several times, with my naked eye, seen many smaller Stars, such as may be call'd of the seventh or eighth magnitude to appear for a short space, and then vanish, which, by directing a small *Telescope* towards that part they appear'd and disappear'd in; I could presently find to be indeed small Stars so situate, as I had seen them with my naked eye, and to appear twinkling like the ordinary visible Stars; nay, in examining some very notable parts of the Heaven, with a three foot Tube, me thought I now and then, in several parts of the constellation, could perceive little twinklings of Stars, making a very short kind of apparition, and presently vanishing, but noting diligently the places where they thus seem'd to play at boe-peep, I made use of a very good twelve foot Tube, and with that it was not uneasy to see those, and several other degrees of smaller Stars, and some smaller yet, that seem'd again to appear and disappear, and these also by giving the same Object-glass a much bigger aperture, I could plainly and constantly see appear in their former places; so that I have observ'd some twelve several magnitudes of Stars less then those of the fix magnitudes commonly recounted in the Globes.

It has been observ'd and confirm'd by the accuratest Observations of the best of our modern Astronomers, that all the Luminous bodies appear above the Horizon, when they really are below it. So that the Sun

Sun and Moon have both been seen above the Horizon, whilst the Moon has been in an Eclipse. I shall not here instance in the great refractions, that the tops of high mountains, seen at a distance, have been found to have; all which seem to argue the Horizontal refraction, much greater then it is hitherto generally believ'd.

I have further taken notice, that not onely the Sun, Moon and Starrs, and high tops of mountains have suffer'd these kinds of refraction, but Trees, and several bright Objects on the ground: I have often taken notice of the twinkling of the reflections of the Sun from a Glass-window at a good distance, and of a Candle in the night, but that is not so conspicuous, and in observing the setting Sun, I have often taken notice of the tremulation of the Trees and Bushes, as well as of the edges of the Sun. Divers of these *Phenomena* have been taken notice of by several, who have given several reasons of them, but I have not yet met with any altogether satisfactory, though some of their conjectures have been partly true, but partly also false. Setting my self therefore upon the inquiry of these *Phenomena*, I first endeavour'd to be very diligent in taking notice of the several particulars and circumstances observable in them; and next, in making divers particular Experiments, that might cleer some doubts, and serve to determine, confirm, and illustrate the true and adequate cause of each; and upon the whole, I find much reason to think, that the true cause of all these *Phenomena* is from the *inflection*, or *multiply refraction* of those Rays of light within the body of the *Atmosphere*, and that it does not proceed from a *refraction* caus'd by any terminating *superficies* of the Air above, nor from any such exactly defin'd *superficies* within the body of the *Atmosphere*.

This Conclusion is grounded upon these two Propositions:

First, that a *medium*, whose parts are unequally *dense*, and mov'd by various motions and transpositions as to one another, will produce all these visible effects upon the Rays of light, without any other *coefficient* cause.

Secondly, that there is in the Air or *Atmosphere*, such a variety in the constituent parts of it, both as to their *density* and *rarity*, and as to their divers mutations and positions one to another.

By *Density* and *Rarity*, I understand a property of a transparent body, that does either more or less refract a Ray of light (coming obliquely upon its superficies out of a third *medium*) toward its perpendicular: As I call Glass a more dense body then Water, and Water a more rare body then Glass, because of the refractions (more or less deflecting towards the perpendicular) that are made in them, of a Ray of light out of the Air that has the same inclination upon either of their superficies.

So as to the business of Refraction, spirit of Wine is a more *dense* body then Water, it having been found by an accurate Instrument that measures the angles of Refractions to Minutes that for the same refracted angle of 30:00' in both those *Mediums*, the angle of incidence in Water was but 41°. 35'. but the angle of the incidence in the trial with spirit of Wine was 42°. 45'. But as to gravity, Water is a more *dense* body then spirit

G g 2